obtaining it from the organic material in the substratum. This is probably true except for lichens that grow in substrata containing no organic material and perhaps for those having thin cortices. ROSENDAHL found that thinness of cortex and presence of calcium oxalate go together in the species of *Parmelia* studied. This would indicate that the algae in lichens with thin cortices obtain their carbon from the air, and so the oxalate is stored in the lichen, while in the lichens with thick cortices the alga secures little or no carbon from the air and utilizes the oxalate obtained from the substratum by the lichen.

These investigations of TOBLER, ARTARI, and others prove that we know little regarding the nutrition of lichens and their algal hosts. The results already obtained are important and suggestive. It is to be hoped that much more work of this kind may be done.—BRUCE FINK.

Metabolism of fats.—IVANOW has published a series of papers on the metabolism of fats in higher plants. He emphasizes how little our knowledge has advanced in this field since the classical work of SACHS, and contrasts it with the advances made in our knowledge of protein metabolism in plants. IVANOW[9] believes he has established that the synthesis of fats from glycerin and fatty acids comes about through the reversible action of lipase, a view apparently well established in animal metabolism.

Another paper[10] deals with the transformation of fats during germination. In order to have seeds with the greatest possible variation in the nature of the fats as regards the saturation of the fatty acids involved, he used flax (very rich in fatty acids of the linoleic type: $C_nH_{2n-6}O_2$), hemp (rich in the linoleic type: $C_nH_{2n-4}O_2$), rape (rich in the oleic type: $C_nH_{2n-2}O_2$), and poppy (rich in the palmitic type: $C_nH_{2n}O_2$). In the developing seedling he finds that the intensity of consumption of the fatty acids originating from the fats is inversely proportional to the degree of saturation. The linoleic type of acid disappears first, and with it of course the hexabromide test; then follows the linoleic, oleic, and finally the palmitic types. The fall in the iodine number of the fat during germination is due to the more rapid transformation of the more unsaturated acids to carbohydrates, and not to their saturation by oxidation leading to the formation of acids with shorter chains. The acid number of the fat from each plant is a strictly determined matter, low when the fats are rich in unsaturated acids, and high when rich in saturated acids. If the constituent parts of the oil in a plant are known, one can approximate closely the acid number of that oil. The unsaturated fatty acids are largely tied up in the glyceride, while the saturated acids exist to a larger degree in the free state. The transformation of the oils during germination is by

[9] IVANOW, SERGIUS, Über Oelsynthese unter Vermittlung der pflanzlichen Lipase. Ber. Deutsch. Bot. Gesells. **29**: 595–602. *fig. 1.* 1911.

[10] ———, Über die Verwandlung des Oels in der Pflanze. Jahrb. Wiss. Bot. **50**: 375–386. 1912.

oxidation to carbohydrates, but the intermediate products are not known and are the next substances for investigation. Since the unsaturated fatty acids are so readily oxidized to carbohydrates (an exothermic process) during germination, the author concludes that their appearance in a plant is a special adaptation, making rapid germination possible by a great liberation of energy. As long as we know so little about the phsyiological use, if any, made of most of the energy liberated by such oxidations, this conclusion is without evidence in its favor.

A third paper[11] deals with the synthesis of fats in oily seeds. In the flax, rape, etc., the testa is formed first, followed by the development of the embryo. Pentosans accumulate early, having their only rôle in the formation of protective structures in the testa and playing no part in nutrition. The carbohydrates (glucose, cane sugar, and starch) are the main substances from which fats are synthesized; while the proteins play a minor if any part in the process. Of the carbohydrates, glucose is first used, followed by the hydrolysis and use of cane sugar, and finally starch. Intense oil formation occupies about two weeks in the middle of the seed development period. Up to the time of the beginning of oil formation, carbohydrates are stored in the stem. At this time the hydrolysis of the carbohydrates in the stem begins, and, due to their transformation to insoluble materials, oils, etc., in the seed, a falling gradient is established in that direction, causing the diffusion to the developing embryo. The first acids formed are saturated, as shown by the iodine number. The author also believes that they belong to the higher members of their respective series, for the Reichert-Meissel number is constant, and it does not vary with the acid number. It is also concluded that the volatile acids play no part in fat synthesis. The acid number varies greatly in the oil from various plants, being very low in oils from seeds rich in unsaturated acids. The author believes the following scheme shows the main features of oil synthesis in a form like the flax seed.

$$\text{glucose (carbohydrates)} \left\langle \begin{array}{c} \text{———— glycerine ————} \\ \\ \text{saturated fatty acids —— unsaturated acids} \end{array} \right\rangle \text{oil}$$

The variation in the iodine number with stages of development is the greater the greater the proportion of the unsaturated acids in the oil. In seeds with few fatty acid components in their oils (rape and hemp) the variation in the physical and chemical characters of the oil with stages of development is slight; while in seeds with oils of many fatty acid constituents (flax and poppy) these variations are great.

It must be remembered that such quantitative analyses cannot certainly determine the series of products and reactions involved in a synthesis, for many

[11] IVANOW, SERGIUS, Über den Stoffwechsel beim Reifen ölhaltiger Samen mit besonderer Berücksichtigung der Oelbildungsprozesse. Beih. Bot. Centralbl. **28**: 159–191. 1912.

of the intermediate products may exist in such small quantities as to escape detection.—WILLIAM CROCKER.

Endogone.—A paper by BUCHOLTZ[12] on the subterranean genus *Endogone* presents an unusually important addition to our knowledge of the group Hemiasci, established by BREFELD to include supposed transitional forms between the Phycomycetes and Ascomycetes. Further study of the forms which were originally placed in the Hemiasci has resulted in the gradual dismemberment of that group until it has lost its taxonomic status. As a result of the work of BUCHOLTZ on *Endogone*, that form also must be removed from the Hemiasci and classed with the Phycomycetes. BUCHOLTZ includes in his account 7 of the 17 species of *Endogone* (including one described as new in his paper). Two of these, *E. lactiflua* Berk. and *E. Ludwigii* Bucholtz, have a sexual process resembling that of the Phycomycetes; *E. macrocarpa* Tul. and *E. microcarpa* Tul. produce only chlamydospores; in *E. pisiformis* Link. the zygospores or chlamydospores of the other forms are represented by sporangia whose contents break up into spores as in the mucors; and in the remaining forms studied, *E. lignicola* Pat. and *E. fulva* (Berk.), the mode of reproduction is not definite. In these either sporangia or thin-walled chlamydospores are produced.

The youngest fruit bodies of *Endogone lactiflua* examined consist of a tissue of interwoven hyphae covered by an outer more firmly interwoven layer, forming a sort of peridium. Foreign hyphae occasionally penetrate the fruit body, but these are easily distinguished from hyphae of *Endogone* by their straight course and parallel walls. The hyphae of *Endogone* are sinuous in their course and have many irregular inflations. Male and female gametangia arise as saclike outgrowths of the hyphae. The nuclei in the gametangia are arranged peripherally and undergo one division. There is no differentiation of the protoplasm into periplasm and ooplasm as in the Peronosporales. A large nucleus, whose origin is not clear, appears in the center of the gametangium. The other nuclei pass toward the base of the gametangium, which is then cut off from the upper uninucleate portion by a wall. The process is the same in both gametangia. The fusion of the uninucleate gametes begins at the time of the formation of the wall. The nucleus of one gamete passes into the other gamete, but no fusion of nuclei takes place. At the apex of the fusion cell, now containing both nuclei, a portion of the wall is gelatinized, and at this point a papillate outgrowth appears, which gradually enlarges as the protoplasm and nuclei pass into it from the fusion cell. This outgrowth

[12] BUCHOLTZ, F., Beiträge zur Kenntnis der Gattung *Endogone* Link. Beih. Bot. Centralbl. **29**:147–225. *pls. 8.* 1912. Originally published in Russian: Neue Beitr. zur Morph. und Cytologie der unterirdischen Pilze. T. I. Die Gattung *Endogone* aus d. Nat.-Hist. Museum d. Gräfin K. Scheremetjeff in Michailowskoje. Moskau **9**:1911. See also preliminary note: Über die Befruchtung von *Endogone lactiflua* Berk. Ann. Myc. **9**:329–330. 1911.